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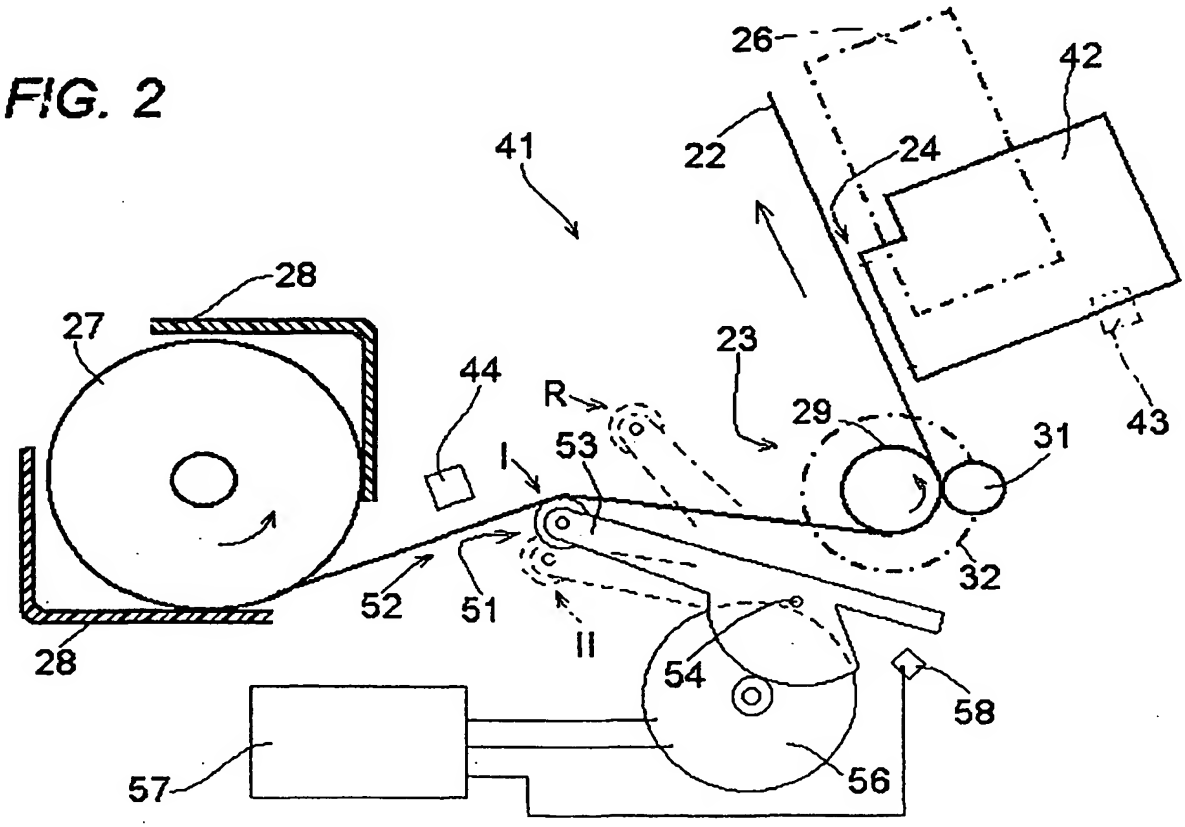
(54) Device for the intermittent feeding of a strip of paper from a roll

(57) A device (41) for intermittently feeding a strip of paper (22) from a roll (27) comprising at least one feeding roller (29) engaging with the strip and interposition means (51) for forming a buffer of paper (52) between roll and roller, wherein the feeding roller (29) is suitable for feeding the strip (22) intermittently towards a printing zone (24). The interposition means (51) variably release a certain amount of paper from the buffer to the feeding roller and comprise control means (47, 56, 57) servodriven in relation to the motion conditions of the feeding roller (29) in order to cause, in a controlled manner, transfer to the roller of a portion of strip from the buffer (52) and withdrawal from the roll (27) of the said portion of strip for reformation of the buffer.

FIG. 2



EP 1 219 454 A2

Description

FIELD OF THE INVENTION

[0001] This invention relates to a device for the intermittent feeding of a strip of paper from a roll.

[0002] More specifically, the invention relates to a device for the intermittent feeding of a strip of paper from a roll comprising at least one feeding roller engaging with the strip and interposition means for forming a buffer of paper between roll and roller according to the introductory part of claim 1.

BACKGROUND OF THE INVENTION

[0003] Such devices are used for instance in printing units, for example for Point-Of-Sale terminals (POS), wherein an ink jet head moves at constant speed in the two printing directions. The strip remains motionless during printing and is fed forward intermittently during the accelerations and braking associated with the inversion of motion. The intermittent movement with very steep ramps can be applied to the feeding roller but cannot be applied to the roll on account of its inertia. In fact, sharp accelerations may cause the paper to tear and sharp braking causes the coils of the roll to slacken.

[0004] In the known devices, the interposition means comprise a spring tensioner which forms a loop on the section of strip before the feeding roller. When feeding starts, the tension exerted by the roller reduces the loop against the action of the spring and dampens jerking movements. When the feeding roller stops, the strip continues to unwind through inertia from the roll but is taken back by the tensioner, thus opposing the slackening of the coils and reforming the buffer.

[0005] The mode of operation of the spring-based interposition means is conditioned by the amount of paper in the roll, by the friction of the roll in its supports and by the resilience of the spring. The effectiveness of these means is furthermore limited to intermittent feeds of the strip of about 1/6", typical of the serial printing of a single line of print.

[0006] Recently POS with "high" heads have been brought out, i.e. POS having a large number of nozzles, for performing simultaneous printing of various lines. The amount of information that can be printed per unit of time is thus dramatically increased. On the other hand, amplitude of the intermittent motion of the strip is of the order of ½" and 1" and the known interposition means cannot manage to work properly during the acceleration and braking ramps of the heads. Accordingly, the times to be allotted for feeding of the strip must be extended beyond those allowed for the inversion of motion, which reduces the printing speeds theoretically achievable.

SUMMARY OF THE INVENTION

[0007] One object of this invention is to produce a device for intermittently feeding a strip of paper from a roll, without any jerking and slackening of the coils during the inversion of motion of a printhead, including the case of simultaneous printing of various lines.

[0008] More generally, the object of the invention is to produce a device for the intermittent feeding of a strip of paper from a roll, which can work at high speed without jerking and without slackening of the coils of the roll.

[0009] These objects are achieved by the device of the invention, in which the interposition means comprise control means servodriven in relation to the motion conditions of the feeding roller, according to the characteristic part of claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The characteristics of the invention will become clear from the description that follows, provided by way of a non-restricting example, and with reference to the accompanying drawings, where:

- Fig. 1 is a partial schematic view of a printing unit with a device for the intermittent feeding of a strip of paper according to the known art;
- Fig. 2 is a partial schematic view of a printing unit with a device for the intermittent feeding of a strip of paper according to this invention;
- Fig. 3 is the block diagram of a control circuit for the device of Fig. 2;
- Fig. 4 is a velocity/time graph of some components of the device of Fig. 2;
- Fig. 5 is an enlarged view of a velocity/time operating diagram of some components of the device of Fig. 2;
- Fig. 6 is another velocity/time graph of the components of Fig. 5; and
- Fig. 7 is yet another velocity/time graph of the components of Fig. 5.

DESCRIPTION OF A PREFERRED MODE FOR CARRYING OUT THE INVENTION

[0011] Depicted in figure 1 with the numeral 19 is a printing unit, for instance for a point of sale terminal (POS), comprising a printhead 21 suitable for writing on a strip of paper 22 and a feeding device 23 for the strip 22.

[0012] The head 21 is of the ink jet type, designed to be displaced in the two directions transversally to the strip 22 in front of a printing zone 24 and with inversion of motion in correspondence with the edges of the strip. The head 21 is moved by a motor 26 at relatively high and constant speed through the zone 24 in order to type a line of print in every pass, and with rapid acceleration and braking at the extremities of the zone 24 where the

inversion of motion takes place.

[0013] The strip of paper 22 is wound in coils on a roll 27 housed in a cradle 28 and the device 23 is adapted for extracting the strip 22 from the roll 27 and feeding it in front of the zone 24.

[0014] Printing takes place during movement of the head 21 at constant speed and while the strip 22 is motionless. To define a new printing zone, the device 23 acts intermittently, moving the strip only during the acceleration and braking steps of the head 21.

[0015] The feeding device 23 comprises a feeding roller 29, a pressure roller 31, a step motor 32 connected to the roller 29 and interposition means between roll and roller. The two rollers 29 and 31 are in engagement with the strip 22 and the motor 32 turns the feeding roller 29 so as to ensure the intermittent motion of the strip.

[0016] The interposition means are arranged for forming a buffer of paper between the roll 27 and the roller 29 so as to reduce the jerks on the strip when the roller 29 starts and to prevent slackening of the coils on the roll when the roller stops.

[0017] According to the known art as depicted in figure 1, the interposition means comprise a tensioning element 36 controlled by a spring 37 and which forms a loop 38 on a section of the strip 22 before the roller 29. At starting, the force exerted by the roller 29 on the strip reduces the loop 38 by flexing the spring 37 and is afterwards transferred on to the outermost coil of the roll 27 causing the roll to unwind in the cradle 26. Extraction of the strip may then continue under the flexing conditions reached by the spring. When the roller stops, through inertia, the roll 27 continues to unwind and the strip yielded is taken back by the element 36 which releases the spring 37 and reforms the buffer.

[0018] The mode of operation of the tensioning element 36 is conditioned by the static and dynamic forces acting on the various components, in particular those in relation to the inertia of the roll 27, to the friction of the outermost coil on the cradle 28 and to the resilience of the spring 37, depending on the conditions of use and in particular on the amount of paper wound in the roll 27.

[0019] Depicted with numeral 41 in figure 2 is a printing unit for POS, having components equal to those of the unit 19 in figure 1, designated with the same numeral but with a "high" printhead 42, i.e. one in which there are more nozzles than those of the head 21.

[0020] Printing takes place during movement of the head 42 at constant speed and while the strip is motionless but, in this case, many lines may be typed at the same time in the printing zone 24.

[0021] The device 23 acts intermittently, moving the strip only during the acceleration and braking steps of the head 42 in which no printing takes place, but over a relatively great length, for example ½" or 1", depending on the number of lines typed in each pass. A sensor 43 for detecting the idle or over-travel position of the head 42 and a sensor 44 for detecting the absence of paper, for example when the roll 27 is finished, are also provided.

[0022] The printing unit 41 is connected to an electronic control unit 46 (Fig. 3), comprising the central unit of the POS not depicted in the figures, an interface circuit 47 and a driving circuit 48 (Fig. 3) for the motors 26 and 32 and in operating connection with the sensors 43 and 44.

[0023] The interposition means include a tensioning element 51 (Fig. 2) for forming a loop 52 on the strip of paper 22 between roll and feeding roller, having a storage or buffer function. The element 51 has for example a roller, engaging with the strip 22 over its entire width, borne by a frame 53 in turn fulcrum-mounted on a pin 54.

[0024] In accordance with the invention, the interposition means comprise control means which are servo-driven in relation to the motion conditions of the feeding roller 29 to cause, in a controlled manner, the transfer to the roller 29 of a portion of strip of the buffer formed by the loop 52 and the withdrawal from the roll 27 of that portion for reformation of the buffer.

[0025] The control means include a motor 56 for the rotation of the frame 53, some sections of the central unit of the POS, the circuit 47 and circuitry means 57 for the motor 56. The motor 56 is suitable for rotating the frame 53 counter-clockwise, reducing the loop 52, and clockwise, thereby increasing it. The motor 56 is a step motor and has a motor pinion meshing with toothing made on an arm of the frame 53. An end of travel sensor 58 is suitable for detecting a reference position of the arm with the toothing, corresponding to a loop 52 of predefined maximum dimensions.

[0026] Through the driving circuit 48 (Fig. 3) and with reference to Fig. 4, the electronic control unit 46 sets acceleration ramps (Ad, As) and braking ramps (Fd, Fs) on the motor 26 in the two directions for the positions of the head 42 adjacent to the zones of inversion, and constant velocity pulses (Vd, Vs) for the printing zone, as indicated in the graph (a). To start and conclude feeding of the strip, the motor 32 is driven to move the roller 29 with acceleration and braking ramps (Ar, Fr) and constant velocity stretches (Vr) depending on the number of line feeds, as indicated in the graph (b), upon each inversion of motion of the head 42.

[0027] The circuitry means 57 (Fig. 2) are pre-arranged for driving the motor 56 in a relation of dependency on the conditions and/or the law of motion set on the motor 32. In detail, the motor 56 is powered so as to turn the frame 53 counter-clockwise with a first acceleration ramp and a first braking ramp (Atr, Ftr), graph (c) in Fig. 4, from the working position "I" to the position "II", depending on the acceleration ramp and/or the constant speed commands on the motor 32 (Ar, Vr), graph (b). The loop 52 decreases and the roller 29 can accelerate the paper without jerking with the roll substantially motionless, with commands for the motor 56 suitable for maintaining the roller of the frame 53 (Fig. 2) in adherence with the strip 22. Then, in sequence, the roller 29 can start extracting the strip from the roll 27, putting it

gradually into rotation and continuing the extraction with the loop constant in the event of a large number of line feeds or a jump.

[0028] Subsequently, in the last stretch at constant speed and the braking ramp of the motor 32 (Vr, Fr), graph (b), the motor 56 is driven to rotate frame 53 clockwise with a second acceleration ramp (Ate), with a section at relatively low constant speed (Vte), and with a second braking ramp (Fte), graph (c), from the position "II" of fig. 2 to the position "I". The frame 53 causes the loop 52 to increase and inertial unwinding of the strip 22 follows. The roller of the frame 53 (Fig. 2) is maintained in adherence with the strip 22 until the roll 27 stops and reforms the buffer. The law of motion imposed on the motor 56 is associated with the constraints of the roll 27 to stop, without fail, the frame 53 in the position "I" in the different conditions of friction of the roll on the cradle 28 and of the amount of paper wound.

[0029] The step of extracting the strip from the roll 27 by the frame 53 and of reforming the buffer may take place at low speed, clearly overlapping with the printing step, as depicted in Fig. 5.

[0030] The circuitry means 57 drive the motor 56 in substantially the same way on each inversion of motion of the head 42.

[0031] In the initialization steps (Fig. 6) there is an initial feeling at a lower speed and stopping (Ari, Vri, Fri) of the motor 32, graph (a). This is followed by driving of the motor 56 to rotate the frame 53 clockwise with an acceleration ramp and a stretch at the low constant initialisation speed (Atei and Vti), graph (b). The loop 52 increases and the strip 22 (Fig. 2) is slowly unwound, until the sensor 58 detects a maximum loop condition, corresponding to a position "R" of the frame 53. The motor 56 is then driven with a braking ramp (Ftei) and stopped. Next, the motor 32 is started again for a feeding cycle of the strip and a loop taking-in cycle 52 (Ar, Vr, Fr), graph (a) and (Atr, Ftr, Ate, Vte, Fte), graph (b).

[0032] The circuitry means 57 (Fig. 2) are easily programmable at design or maintenance time to extract from the roll 27 a portion of strip according to a law of motion such as to minimize its tensions in the acceleration steps and the slackening of the coils of the roll in the braking steps even under limit conditions, by modifying the ramps.

[0033] By way of example, provision could be made to modify the law for extraction of the strip by taking into account the diameter of the roll using a coils sensor or external commands for changes in the type of paper or in the device's operating conditions.

[0034] More simply, the law of motion of the motor 56 could be changed solely in relation to the roll full condition, which is the most critical for the purposes of excessive tensions on the strip. This condition typically arises when a finished roll is substituted for a new one.

[0035] To advantage, this could be associated with the sequences in which the sensor 44 detects the absence of paper condition due to the roll being finished and which is followed by the annulling of the paper-out condition due to substitution of the roll. Recognition of these sequences could trigger off a programme of ramps for the, motor 56, different from the normal ones.

[0036] The ramps for a full roll are illustrated, for instance, in the graph (b) of Fig. 7, in relation to the graph (a) of the motor 32 and substantially identical to that of graph (a) in Fig. 5.

[0037] Obviously, without prejudice to the principle of this invention, the embodiments and construction details may be abundantly varied with respect to what has been described and illustrated purely by way of non-restrictive example, without exiting from the scope of the invention.

[0038] For instance, the place of the motor 56 could be taken by other linear actuators, such as suitably programmed electromagnets. The motor could also be of the direct-current and impulse-control type and having control of one or more reference positions.

[0039] Conversely, where the motor 56 is a step motor as described above, the over-travel sensor 58 could be removed and control of the position "R" be entrusted instead to a fixed abutment on the frame 53, to be reached slowly in the initialization step, according to a known technique.

[0040] Although the device has been applied to a printing unit, it could also be used to advantage in other sectors wherein a strip of paper is unwound from a roll and subjected to an intermittent feeding.

Claims

1. Device (41) for the intermittent feeding of a strip of paper (22) from a roll (27) comprising at least one feeding roller (29) engaging with the strip and interposition means (51) for forming a buffer of paper (52) between said roll and said roller, wherein the feeding roller feeds the strip intermittently towards a printing zone (24) and the interposition means variably release a certain amount of paper from the buffer to the feeding roller (29), **characterized in that** said interposition means (51) are associated with control means (47, 56, 57) which are servodriven in relation to the motion conditions of the feeding roller (29), so as to produce, in a controlled manner, transfer to the roller of a portion of strip (22) from the buffer (52) and withdrawal from the roll (27) of the said portion of strip for reformation of the buffer.

2. Device according to claim 1, **characterized in that** said control means (47, 56, 57) are arranged for reducing the buffer of paper at the start of motion of the feeding roller (29) in order to keep the roll (27) substantially motionless.

3. Device according to claim 2, **characterized in that** said control means (47, 56, 57) reduce said buffer

ensuring a gradual start-up of the above-mentioned roll (27).

4. Device according to claim 1 or 2 or 3, **characterized in that** said control means (47, 56, 57) are arranged for reforming the buffer (52) at the end of the motion of the roller (29), taking back the above-mentioned portion of strip and/or unwinding it from the roll (27).

5. Device according to any of the previous claims, **characterized in that** it is employed in a printing unit (19) in which a head (21, 42) is movable transversally to the strip for the printing of one or more lines and in which the feeding of the strip (22) takes place during the inversion of motion of the head, and the reforming of the buffer (52) may also take place during the printing of one or more lines.

6. Device according to claim 5, **characterized in that** it is employed in a printing unit (19) in which the head (42) is of the ink jet type with a large number of nozzles for the simultaneous printing of numerous lines.

7. Device according to any of the previous claims, **characterized in that** the control means (47, 56, 57) are adapted for taking back and/or extracting from the roll (27) said portion of strip according to a law of motion such as to minimize the tensions on the strip in the acceleration step and the slackening of the coils of the roll in the braking steps.

8. Device according to any of the previous claims, wherein said interposition means comprise a tensioning element (51) engaging with the strip of paper (22) for forming a loop (52) between roll (27) and feeding roller (29) and which constitutes the above-mentioned buffer, **characterized in that** said control means (47, 56, 57) comprise a servomotor (56, 57) for moving the tensioning element (51) in a given direction and in an opposite direction, the above-mentioned given direction being associated with the starting of feeding of the strip (22) and with the reduction of the loop (52), and the opposite direction being associated with the stopping of feeding of the strip and the increase of the above-mentioned loop with reformation of the buffer.

9. Device according to the claims 5 or 6 and 8, **characterized in that**, for the reformation of the buffer, said servomotor (56, 57) is adapted for moving the tensioning element (51) at low speed during the above-mentioned printing.

10. Device according to claim 8 or 9, in which said feeding roller (29) is actuated by a first motor (32) and by first circuitry means (48) to impose on said first motor corresponding acceleration ramps (Ar) when the feeding movement of the strip (22) starts, **characterized in that** said servomotor comprises a second motor (56) and said control means comprise second circuitry means (57) for driving the second motor with a given acceleration ramp (Atr) and a given braking ramp (Ftr) in the above-mentioned given direction and associated with the acceleration ramp of the feeding roller.

11. Device according to claim 10, in which the first circuitry means (48) impose on the first motor (32) corresponding braking ramps (Fr) at the end of the strip feeding movement, **characterized in that** said second circuitry means (57) are adapted for driving the second motor (56) with a second acceleration ramp (Ate) and a second braking ramp (Fte) in the above-mentioned opposite direction and associated with the braking ramp of the feeding roller.

12. Device according to one of the claims from 8 to 11, wherein said feeding roller (29) is actuated by a first step motor (32), **characterized in that** said servomotor comprises a second step motor (56).

13. Device according to one of the claims from 8 to 12, **characterized in that** it comprises a sensor (58) associated with the tensioning element (51) for detecting a reference position "R" of the above-mentioned element (51) corresponding to a predetermined loop and in which said control means (47, 56, 57) are adapted for controlling the servomotor dependent on the above-mentioned associated sensor (58).

14. Device according to one of the claims from 8 to 13, **characterized in that** it comprises a paper-out sensor (44) adapted for detecting a condition of roll (27) finished and in which said control means (47, 56, 57) are adapted for controlling said servomotor (56, 57) dependent on a sequence detected by the above-mentioned sensor (44) which comprises the detecting of the paper-out condition, followed by the annulling of the above-mentioned paper-out condition.

15. Device according to one of the claims from 8 to 14, **characterized in that** said tensioning element (51) comprises a frame (53), liable to rotate, having a roller engaging with said strip (22) between the roll (27) and the feeding roller (29) and meshing with a pinion of the above-mentioned servomotor (56, 57).

FIG. 1

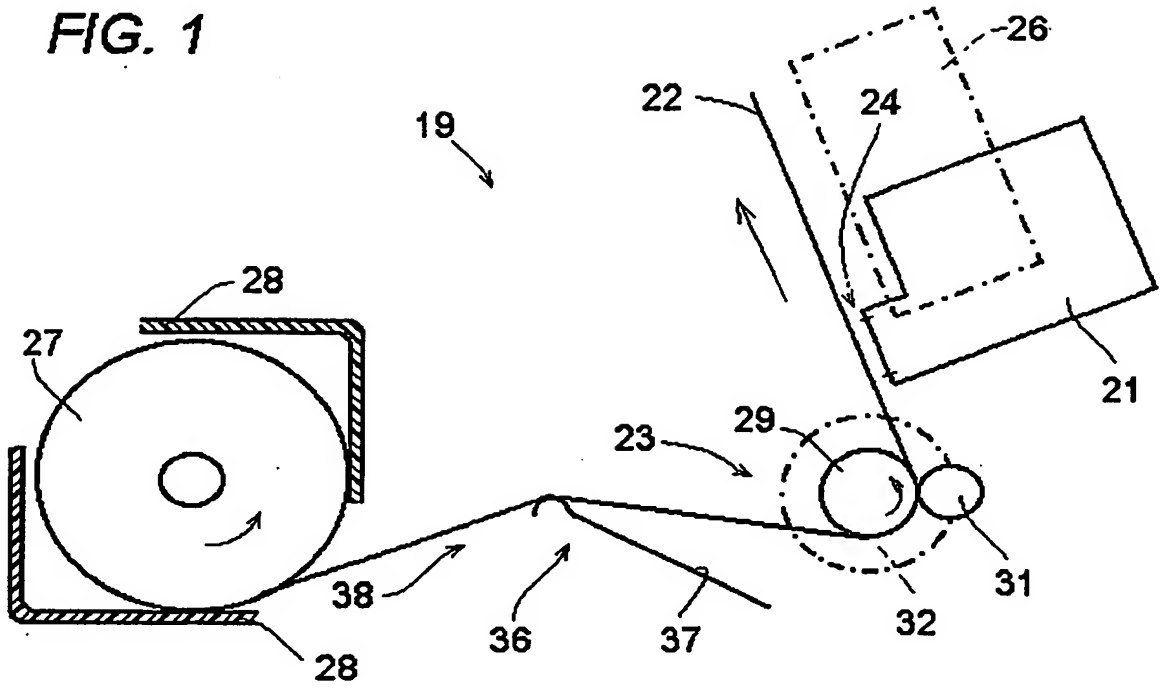

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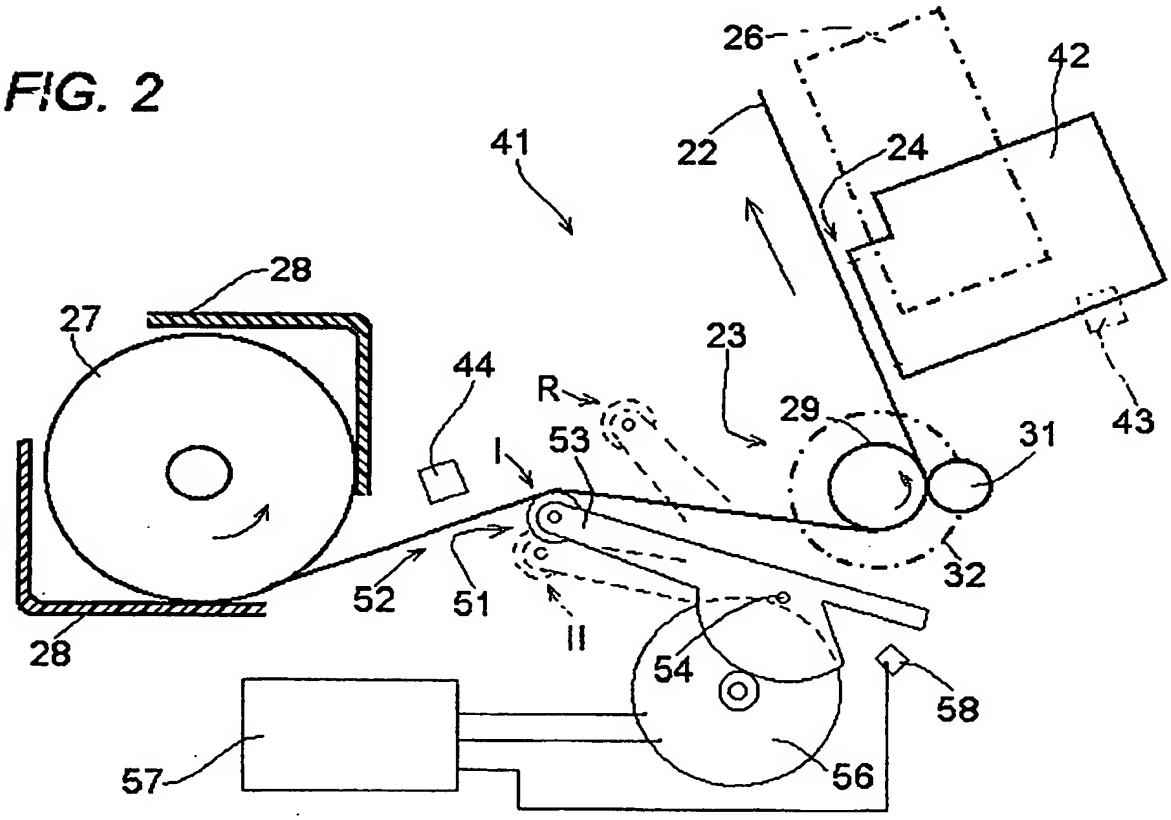
FIG. 2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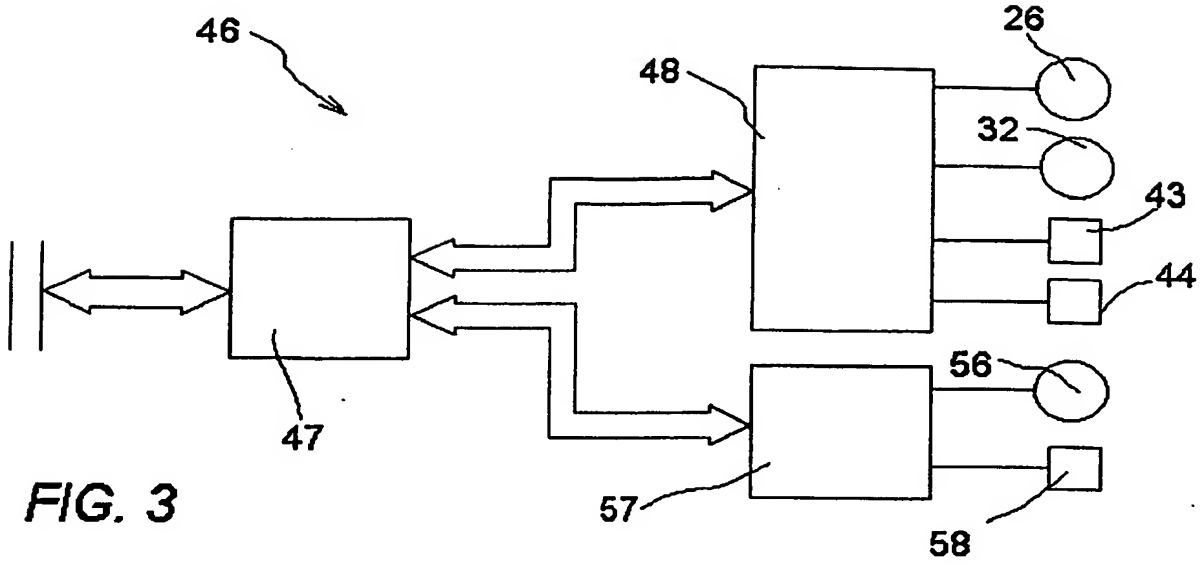
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FIG. 3

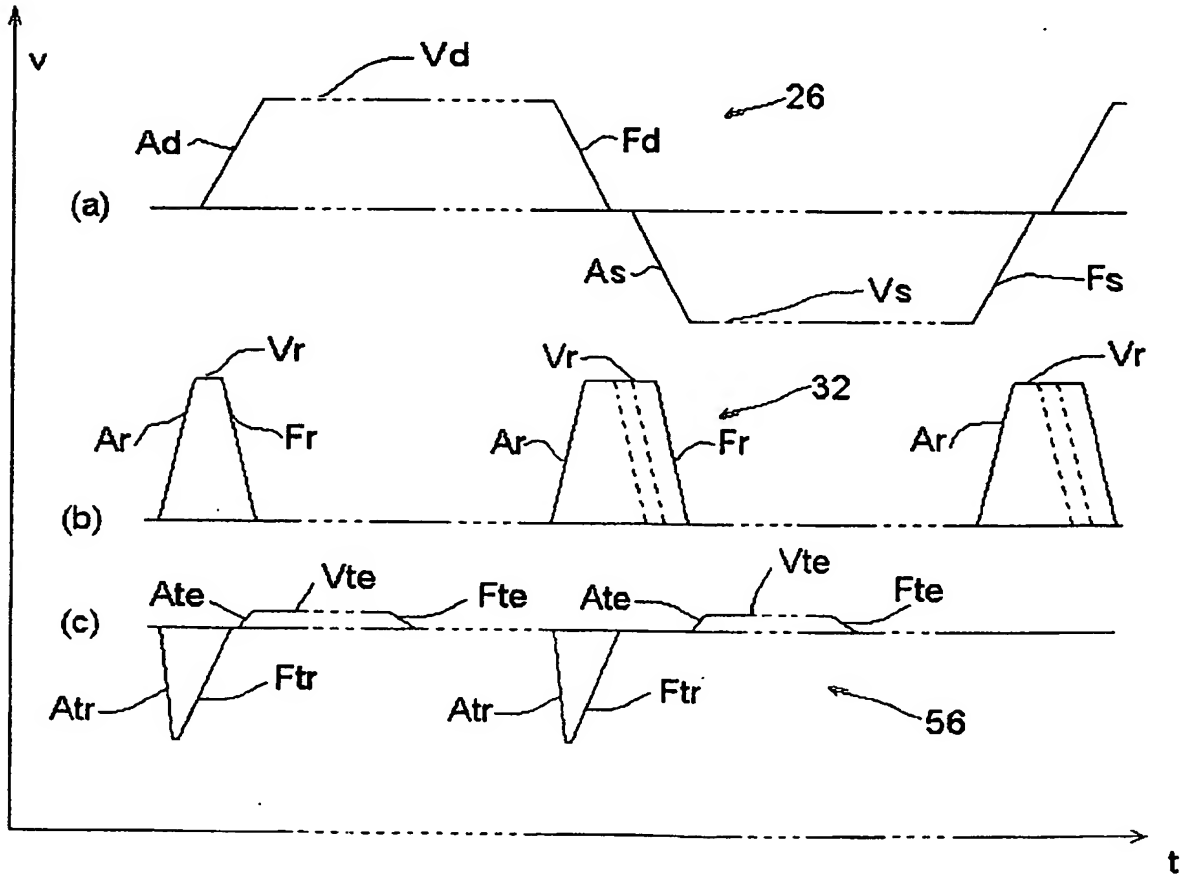
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FIG. 4

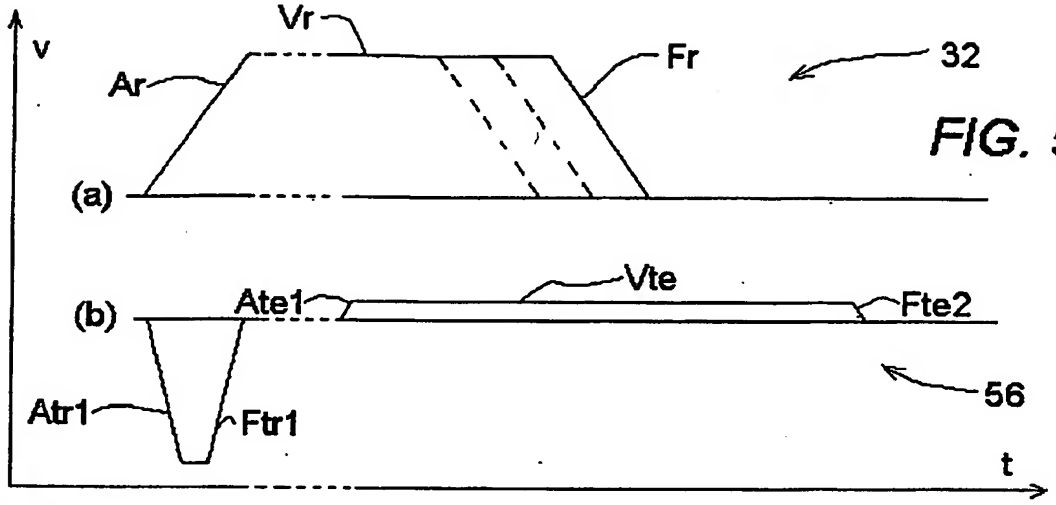

FIG. 5

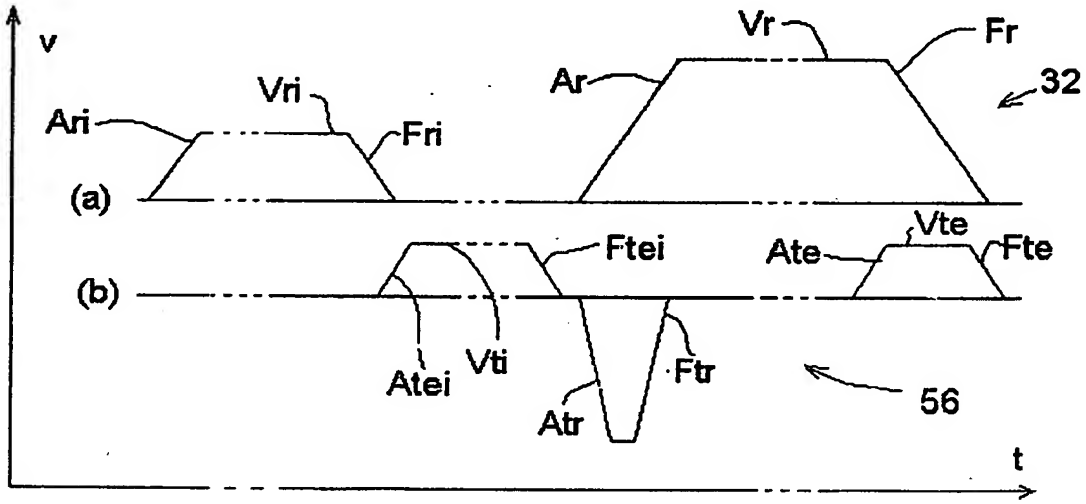

FIG. 6

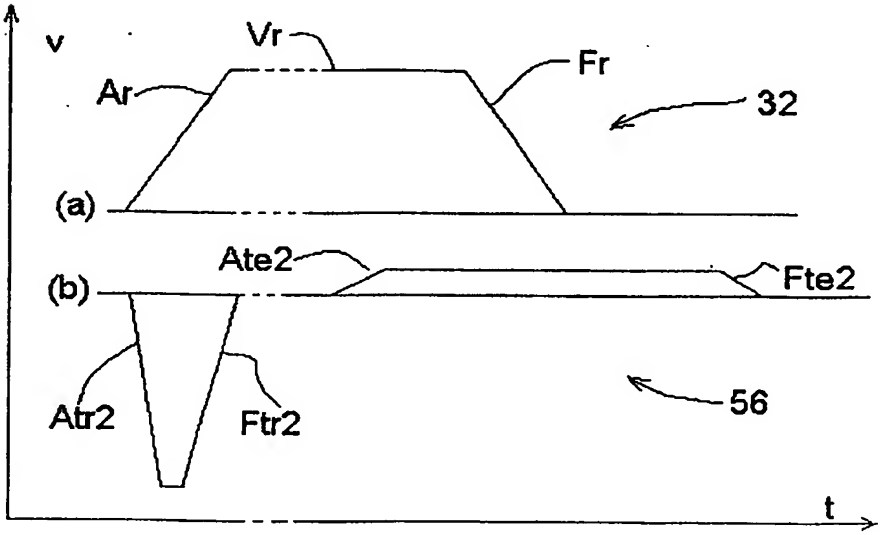

FIG. 7

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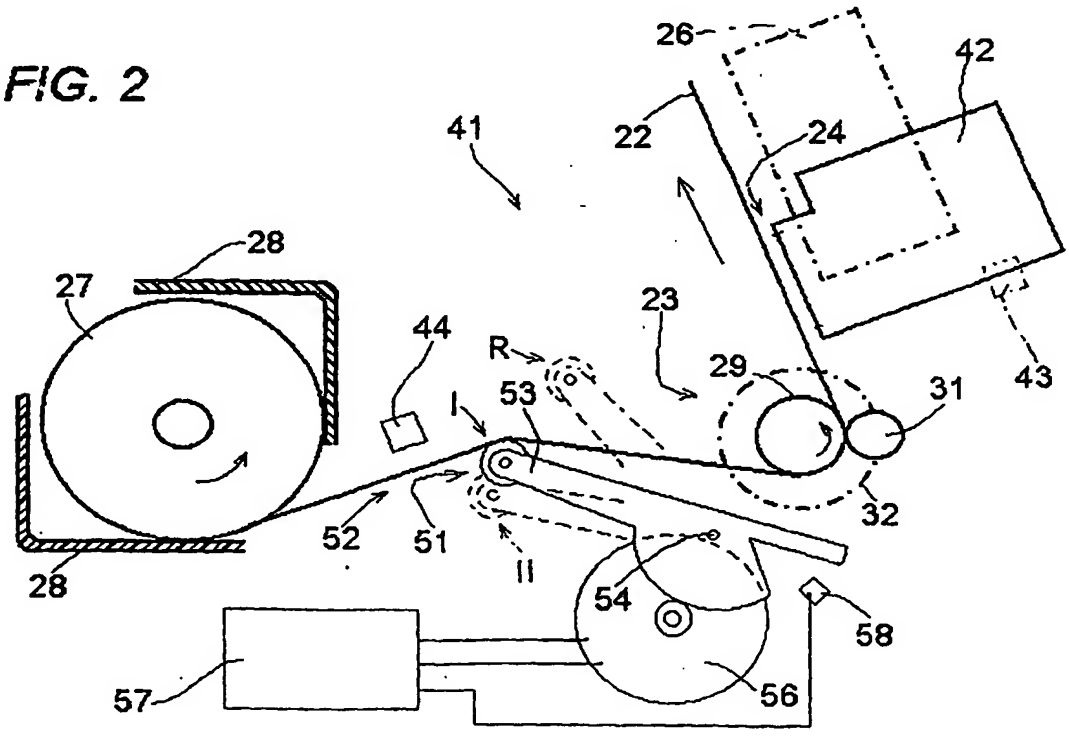
FIG. 2



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EUROPEAN SEARCH REPORT

Application Number
EP 01 13 0057

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X A	GB 2 250 273 A (MOLINS PLC) 3 June 1992 (1992-06-03) * page 3, line 4 - page 4, line 33; figure 1 *	1-3 5-9, 13-15	B41J15/04
X A	US 5 717 836 A (HORIE ATSUYUKI) 10 February 1998 (1998-02-10) * column 3, line 61 - column 5, line 60; figure 2 *	1-3 5-11, 13-15	
A	US 5 791 541 A (FUJIO NOBORU ET AL) 11 August 1998 (1998-08-11) * column 13, line 8 - column 14, line 14; figure 1 *	1-3,7-9, 13	
A	US 5 468 080 A (JONES WILLIAM B) 21 November 1995 (1995-11-21) * column 3, line 39 - column 4, line 44; figure 1 *	1-5,7-9, 12-14	
A	EP 0 435 216 A (DAINIPPON SCREEN MFG) 3 July 1991 (1991-07-03) * column 4, line 43 - column 6, line 30; figure 2 *	1-3,7-9, 13	TECHNICAL FIELDS SEARCHED (Int.Cl.7) B41J B65H
A	PATENT ABSTRACTS OF JAPAN vol. 018, no. 431 (M-1653), 11 August 1994 (1994-08-11) & JP 06 127773 A (HITACHI SEIKO LTD), 10 May 1994 (1994-05-10) * abstract *	1-3,7-9	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	28 May 2003	Zacchini, D

CATEGORY OF CITED DOCUMENTS

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28-05-2003

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